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A New Subgenus and Six New Species of Chigger Mites (Genus Trombicula) from the Central United States[1, 2]

By

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ABSTRACT: The following larval chigger mites of the genus *Trombicula* are described from the central United States. A new subgenus *Euschöngastoides* is proposed with *Trombicula hoplai* sp. nov., as the type and only species. This chigger mite is known from south-central Kansas to northern Texas and westward to western Colorado. The other new species are *Trombicula* (*Leptotrombidium*) *twentei*, known from south-central Kansas; *T. crossleyi* from south-central Kansas and south-central Oklahoma; *T. fitchi* from south-central and eastern Kansas, southeastern Nebraska and central Illinois; the closely related *T. kardosi* taken in eastern Kansas and southwestern Utah; and *T. arenicola* from southwestern Kansas west to western Utah and north to Alberta, Canada.

INTRODUCTION

A study of the larval chigger mites from Kansas and other central states has revealed six species belonging to the genus *Trombicula*, which seem to be new and are described below. One of the new species is considered significantly different from other described species and subgenera of *Trombicula* and is placed in a new subgenus.

I wish to express my appreciation to Mr. Louis J. Lipovsky for generously allowing access to his notes and sketches of *Trombicula fitchi* sp. nov. and *T. hoplai* sp. nov. Sincere thanks are extended to Dr. James M. Brennan of the Rocky Mountain Laboratory, U. S. Public Health Service, for examining several of the species and for the loan of specimens of *T. fitchi* and *T. arenicola* sp. nov. (listed below as RML). Dr. Brennan graciously sent these species which

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he was prepared to describe. I am grateful to the following persons for their help in assembling these larval chigger mites while at the University of Kansas; Mr. D. A. Crossley, Jr., Mr. Robert E. Elbel, Mr. Robert B. Finley, Jr., Dr. Henry S. Fitch, Mr. J. Knox Jones, Jr., Mr. Ervin H. Kardos, Mr. Louis J. Lipovsky, and Mr. Keith A. Wolfenbarger. Mr. David T. Clark of the University of Illinois, and Dr. Cluff E. Hopla of the University of Oklahoma also aided in collecting larval chiggers, for which I express my appreciation. The writer also wishes to thank Mr. Crossley, Dr. Fitch and Dr. Charles D. Michener of the University of Kansas for carefully reading the manuscript.

DESCRIPTION OF SPECIES

The terminology used throughout the paper is that of Wharton, *et al.* (1951). All of the measurements are in microns. Each description is based upon the holotype, with differences among the paratypes indicated in parentheses. All of the larvae were studied under a phase contrast microscope, with the specimens mounted on slides in polyvinyl alcohol medium (see Lipovsky, 1953). Drawings were made from specimens in the type series, with the aid of a camera lucida. Unless otherwise indicated, the specimens are in the Snow Entomological Museum, University of Kansas, with the slide numbers preceded by the initials KU.

Trombicula crossleyi * sp. nov.

Figs. 1-3

Types.—Larvae: Holotype, slide KU 3075, and 24 paratypes, KU 3069-74 and 3076-93, Snow Entomological Museum, University of Kansas, from 10½ miles west of Hardtner, Barber County, Kansas, taken from four red-headed woodpeckers, *Melanerpes erythrocephalus* (Linnaeus), field number RL520726-9, shot on July 26, 1952, by R. B. Loomis and D. A. Crossley, Jr.

Diagnosis.—Larva similar to *Trombicula trisetica* Loomis and Crossley, 1953, in having a small elongate body; palpal claw bifurcate with axial prong internal (and ventral); one masitarsala III, three pairs of sternal setae; eight dorsal setae in the first posthumeral row; and in having similar nude setae on the legs. *Trombicula crossleyi* differs from *T. trisetica* in having a scutum smaller with more distinctly protruding posterolateral corners, sensillae shorter with more numerous branches, galeal seta usually with a single

* Named in honor of Mr. D. A. Crossley, Jr., my associate in the University of Kansas Chigger Project, who helped to collect the type series and successfully reared this species in the laboratory.

branch, and in having the coxae III with five or more setae on at least one coxa, four to six setae on the other.

Description of larva.—Body: Holotype (partially engorged) 255 by 168 (unengorged 170 by 128, fully engorged 315 by 200), yellow in life. Eyes 2/2, bright red in life, subequal, ocular plate indistinct, length across both eyes 19, width 8.

Dorsal body setal formula 2-8-6-6-7-4-2-2, total 37 (36-38); humeral seta measures 30, anterior dorsal seta 24, posterior dorsal seta 21. Ventral setal formula approximately 2-2-2-7-7-5-6-6-4, total 41 (40-42); anterior sternal seta measures 19, third sternal seta 16, anterior ventral seta 17, posterior ventral seta 19. Total body setae approximately 78. (See Loomis and Crossley, 1953:33, figs. 1 and 2, for the general appearance of the body, as illustrated in the closely related *Trombicula trisetica.*)

Scutum: Subpentagonal, with a slightly angular posterior margin, the posterior corners slightly protruding; punctae small; posterolateral seta longer than anterolateral seta; sensilla flagelliform with 15 long branches on distal three fourths, several short barbs near base; bases of sensillae situated nearly equidistant between anterior and posterior margins of scutum, and nearly in line with the midpoints between antero- and posterolateral setae. Scutal measurements of holotype: AW- 34, PW- 46, SB- 12, ASB- 22, PSB- 20, AP- 22, AM- 20, AL- 17, PL- 27, S- 34. Averages and extremes of eight paratypes: AW- 35 (32-38), PW- 45 (43-47), SB- 12 (12-13), ASB- 20 (20-22), PSB- 20 (20-22), AP- 21 (20-22), AM- 20.5 (20-21), AL- 18 (17-19), PL- 26.5 (25-28), S- 33 (30-35).

Gnathosoma: Cheliceral blade long and slender, slightly curved; one prominent dorsal tricuspid cap; cheliceral base punctate. Galeal seta with a single branch (occasionally nude). Capitular sternum punctate, with one pair of branched setae. Palpal femur and genu each with a branched seta; three tibial setae each with at least one branch; tarsus with a basal spur (5μ), one stout branched seta, one seta with numerous branches and three setae each with one or two branches; palpal claw bifurcate, prongs nearly equal in length, inner prong axial, ventral and curved slightly inward.

Legs: Setation similar to *T. trisetica* except for number of setae on coxa III (see Loomis and Crossley, 1953:32-34). All leg segments with faint punctae. Nude setae and setae on coxa III are as follows: Leg I, three genualae and a microgenuala; two tibialae and a microtibiala; tarsus with a spur (11μ), microspur, subterminala, parasubterminala and pretarsala. Leg II, a genuala; two

tibialae; tarsus with a spur (10μ), microspur, and pretarsala. Leg III, coxa with five branched setae (occasionally four or six on one side); a genuala; tibiala; and mastitarsala.

Remarks.—In the type series of 25 specimens the number of setae on coxa III are as follows: 12 with four and five setae; 10 with five setae; 2 with five and six setae; and 1 with six setae on both coxae.

Mr. D. A. Crossley, Jr. successfully reared this species through a complete generation, from larvae taken with the type series. Paratype KU 3093 is a reared larva.

Specimens examined.—Total, 41 larvae, as follows. KANSAS. *Barber Co.:* 10½ mi. W Hardtner, *Melanerpes erythrocephalus,* July 26, 1952, KU 3069-93 (type series); 5 mi. S Sun City, *Melanerpes erythrocephalus,* Sept. 13, 1948, KU 3029-30; 4 mi. S Aetna, *Peromyscus leucopus,* Oct. 7, 1951, KU 3064-67, 3068 (3 specimens), 3098 (3), July 25, 1952, KU 3094. OKLAHOMA. *Comanche Co.:* Wichita Wildlife Refuge, *Peromyscus maniculatus,* KU 3095-96, and *Peromyscus leucopus,* KU 3097, May 16, 1952.

Trombicula (*Leptotrombidium*) *twentei* * sp. nov.

Figs. 4-9

Types.—Larvae: Holotype, slide KU 3101, and eight paratypes, KU 3102-3109, Snow Entomological Museum, University of Kansas, from 4 miles south of Aetna, Barber County, Kansas, taken from seven Bunker Bats, *Antrozous bunkeri* Hibbard, on February 25, 1953, by J. W. Twente, Jr.

Diagnosis.—Engorged larva large (body 782 by 484 in holotype), with a total of approximately 120 body setae; palpal femur, genu and tibia with nude setae; galeal seta branched; palpal claw trifurcate; scutum trapezoidal, with the posterior margin concave; sensillary bases near posterior margin, in line with the bases of PL's; sensilla long, flagelliform with several long distal branches; and no whiplike setae on Leg III. Possibly related to *Trombicula myops* Vitzthum, 1931 and *Trombicula* (*Leptotrombidium*) *mexicana* Ewing, 1937,† from bats in Venezuela and San Luis Potosí, Mexico, respectively, differing from *T. myops* in the greater number of body setae, 120, (67 figured by Vitzthum, 1931, for *T. myops*); other important characters of *T. myops* unknown to author. From

* Named for Mr. John W. Twente, Jr., of the University of Michigan, who obtained the type series.

† Neither of these species has been examined by me. The type of *T. mexicana* is in the United States National Museum, according to Wharton and Fuller (1952:54). The location of the type of *T. myops* is unknown (*op. cit.*:67). Wharton and Fuller (*op. cit.*:51) defined the subgenus *Leptotrombidium*, and placed *T. mexicana* in it. *Trombicula twentei* is also placed in the subgenus, indicating a close similarity.

T. mexicana, *T. twentei* differs in having scutum with more pronounced punctae and concave posterior margin (rounded in *T. mexicana*), sensillary bases in line with bases of the PL's (anterior to PL's in *T. mexicana*), and 62 dorsal setae [as compared to 38-40 in *T. mexicana* according to Ewing (1937:173)].

Description of larva.—Body: Holotype (fully engorged) 782 by 434, pale in life. Eyes 2/2, anterior slightly larger, ocular plate faint, seen between paired eyes, distance across pair of eyes 24, greatest width 12.

Dorsal setal formula approximately 2-10-6-13-2-10-2-8-4-6, total 62; humeral seta measures 49, anterior dorsal seta 33-39, posterior dorsal seta 35. Ventral setal formula 2-2 plus 36 anterior and 18 posterior to anus; anterior sternal seta measures 39, posterior sternal seta 26, anterior ventral seta 25, posterior ventral seta 40. Total body setae approximately 120.

Scutum: Roughly rectangular or trapezoidal, with posterior margin concave, large scattered punctae, setae at apices, sensillary bases in line with bases of PL's, close to posterior margin. Sensilla long, flagelliform, with 13 long branches on distal two thirds. Scutal measurements: AW- 63, PW- 80, SB- 26, ASB- 34, PSB- 11, AP- 28, AM- 47, AL- 35, PL- 47, S- 77. Averages and extremes of the nine types: AW- 62 (58-66), PW- 79 (75-83), SB- 27.5 (25-29), ASB- 33 (31-34), PSB- 12 (11-13), AP- 29 (28-31), AM- 49 (47-52), AL- 36 (35-38), PL- 48 (46-53), S- 79 (76-83).

Gnathosoma: Cheliceral blade long and slender, slightly curved, one prominent dorsal tricuspid cap. Faint punctae on cheliceral base. Galeal seta with five branches (4-6 in paratypes). Capitular sternum with few scattered punctae and a pair of branched setae. Palpal femur, genu and tibia with all setae nude; tarsus with basal spur (8μ), one nude and five branched setae. Palpal claw trifurcate, with a large central prong and two small lateral prongs.

Legs: Leg I coxa, trochanter and basifemur each with one branched seta; telofemur with five branched setae; genu with four branched setae, two genualae and a microgenuala; tibia with eight branched setae, two tibialae and a microtibiala; tarsus with approximately 17 branched setae, a spur (23μ), microspur, subterminala; parasubterminala and pretarsala. Leg II coxa and trochanter each with one branched seta; basifemur with two branched setae; telofemur with four branched setae; genu with three branched setae and a genuala; tibia with six branched setae and two tibialae; tarsus with approximately 16 branched setae, a spur (20μ), microspur and pretarsala. Leg III coxa and trochanter each with one

branched seta; basifemur with two branched setae; telofemur with four branched setae; genu with three branched setae and a genuala; tibia with six branched setae and a tibiala; tarsus with approximately 13 branched setae; no whiplike setae on leg III. All leg segments with faint punctae.

Remarks.—*Trombicula twentei* may be closely related to other bat-infesting chiggers, such as *Trombicula myops, T. mexicana,* and the Asiatic species, *T. insolli* Philip and Traub, *T. piercei* Ewing, and *T. revellae* Audy. The Asiatic species seem to resemble *T. twentei,* but the former have more nude setae on leg III.

Specimens examined.—Total, 9 larvae, of the type series.

Euschöngastoides subgen. nov.

Type.—*Trombicula* (*Euschöngastoides*) *hoplai* sp. nov.

Diagnosis.—Differs from other described subgenera of the genus *Trombicula* in lacking subterminala and parasubterminala on leg I, lacking nude setae on genual segments of legs II and III, and having only four branched setae and a basal spur on palpal tarsus. Seemingly not closely related to other species or subgenera in *Trombicula,* but probably closer to *Euschöngastia lacerta* Brennan, which possesses many characteristics of *Euschöngastoides* except for presence of clavate sensillae. *Euschöngastia lacerta* differs from the genus *Euschöngastia, sensu stricto,* in several important characters, and may actually belong in *Euschöngastoides* despite presence of expanded clavate sensillae.

Description of the subgenus.—Larva: Palpal claw trifurcate, with basal part long and slender; four branched setae and a short basal spur on palpal tarsus; scutum roughly rectangular, without punctae, and with five normal plumose setae; sensilla flagelliform and plumose; body setae plumose; tarsus I without subterminala and parasubterminala; genu II and III without nude setae (genualae); leg III without whiplike setae; coxa III with one seta.

Trombicula (*Euschöngastoides*) *hoplai** sp. nov.

Figs. 10-15

Types.—Larvae: Holotype, slide KU 3150, and 23 paratypes, KU 3129-3149 and 3177-78, Snow Entomological Museum, University of Kansas, from 4½ miles south, 1 mile west of Aetna, Barber County, Kansas, taken from three prairie dogs, *Cynomys ludo-*

*Named for Dr. Cluff Hopla of the University of Oklahoma, in appreciation of his many generous donations of chiggers and chigger hosts from Kansas, Oklahoma and Utah.

vicianus (Ord), field no. RL520727-4, shot on July 27, 1952, by R. B. Loomis and D. A. Crossley, Jr.

Diagnosis.—Larva with palpal claw slender, trifurcate; palpal setae branched except for lateral tibial seta nude; palpal tarsus with only four branched setae and a short basal spur; galeal seta nude; scutum roughly rectangular without punctae; sensilla plumose, with branches or basal barbs along entire length; four humeral setae; first posthumeral row with 10-12 setae; total body setae approximately 106; tarsus I without subterminala and parasubterminala; leg II without genuala; leg III without genuala and without whiplike setae. Unique among described species of *Trombicula.* Relationship possibly with *Euschöngastia lacerta* Brennan, 1948. See discussion under diagnosis of the subgenus *Euschöngastoides.*

Description of larva.—Body: Holotype (partially engorged) 370 by 289 (engorged 670 by 493), white in life. Eyes 2/2, pink in life, anterior larger, ocular plate obscure, distance across both eyes 21, width 9.

Dorsal setal formula 4-12 (10)-2-8-8-10-8-4-2, total 58 (56-58); humeral seta measures 34, anterior dorsal seta 27, posterior dorsal seta 22. Ventral setal formula approximately 2-2-8-8-6 plus 20, total 46; anterior sternal seta measures 34, posterior sternal seta 26, anterior ventral seta 21, posterior ventral seta 23. Body setae plumose, total approximately 104.

Scutum: Roughly rectangular, wider than long, posterior margin slightly convex without distinct punctae, anterolateral seta usually arched (fig. 11); sensillary bases slightly anterior to bases of the posterolateral setae; sensillae with barbs on proximal half, enlarging to numerous branches on distal half. Scutal measurements of holotype: AW- 56, PW- 66, SB- 21, ASB- 22, PSB- 13, AP- 19, AM- 25, AL- 27, PL- 33, S- 53. Averages and extremes of five types: AW- 53 (51-56), PW- 65 (63-70), SB- 21 (21-22), ASB- 22 (21-23), PSB- 14 (13-16), AP- 19 (19-20), AM- 25 (24-26), AL- 26 (23-27), PL- 28 (26-33), S- 53 (50-56).

Gnathosoma: Cheliceral blade long and slender, slightly curved, one prominent dorsal tricuspid cap, cheliceral base punctate. Galeal seta nude. Palpal femur and genu each with one branched seta; tibia with dorsal and ventral setae branched, lateral seta nude; tarsus with basal spur (6μ) and four feathered setae. Palpal claw trifurcate, long and slender curving slightly inward, with prongs of unequal length.

Legs: Leg I coxa, trochanter and basifemur each with one

branched seta; telofemur with five branched setae; genu with four branched setae, two long genualae and a microgenuala; tibia with eight branched setae, two stout tibialae and a microtibiala; tarsus with approximately 14 branched setae, a spur (10μ), microspur, and pretarsala. Leg II coxa and trochanter each with one branched seta; basifemur with two branched setae; telofemur with four branched setae; genu with three branched setae; tibia with six branched setae, two tibialae; tarsus with approximately 14 branched setae, a spur (16μ), microspur and pretarsala. Leg III coxa and trochanter each with one branched setae; basifemur with two branched setae; telofemur with three branched setae; genu with three branched setae; tibia with six branched setae and tibiala; tarsus with approximately 14 branched setae; no whiplike setae on leg III. All leg segments with faint punctae.

Remarks.—Trombicula hoplai has been found attached to the body rather than the ears of the hosts. The hosts were obtained in the plains and canyons in Kansas and Texas and in the lower elevations bordering the Rocky Mountains. Larval activity seems to be restricted to the summer.

Specimens examined.—Total, 50 larvae, as follows. COLORADO. *Mesa Co.:* 1 mi. SW Mack, 4600 ft., *Neotoma lepida,* Sept. 8, 1948, KU 3572-73. KANSAS. *Barber Co.:* 4 mi. S. Aetna, *Neotoma micropus,* Aug. 22, 1949, KU 3110-18, 3577, July 25, 1952, KU 3121-28—*Peromyscus leucopus,* July 25, 1952, KU 3119-20, Oct. 7, 1951, KU 3068, 3098; 4½ mi. S, 1 mi. W Aetna, *Cynomys ludovicianus,* July 27, 1952, KU 3129-3150, 3177-78 (type series). NEW MEXICO. *San Juan Co.:* 18 mi. N, 1 mi. E Farmington, 6000 ft., *Neotoma mexicana,* Aug. 10, 1949, KU 3574. TEXAS. *Wichita Co.:* Wichita Falls, *Citellus tridecemlineatus* July 25, 1953, KU 3575.

Trombicula fitchi * sp. nov.

Figs. 16-18, 20

Types.—Larvae: Holotype, slide KU 3181, and 53 paratypes, KU 3180 and 3182-88, Snow Entomological Museum, University of Kansas, from 4 miles south of Aetna, Barber County, Kansas, taken from several hundred cave bats, *Myotis velifer* (Allen), field no. RL490410-1, collected April 10, 1949, by R. B. Loomis, L. J. Lipovsky and K. A. Wolfenbarger; and nos. 3196-3240, second generation larvae, reared from engorged larvae with the same data.

* Named in honor of Dr. Henry S. Fitch, Resident Naturalist at the University of Kansas Natural History Reservation, in appreciation of the constant aid and encouragement given the writer while studying chigger mites.

Diagnosis.—Larva with palpal claw trifurcate; palpal femur, genu and tibia with all setae branched; galeal seta with several branches; scutum pentagonal, posterior margin broadly rounded; sensilla flagelliform, with approximately 15 branches on distal two thirds, a few barbs on proximal third; first posthumeral row with six setae. Similar to *Trombicula* (*Neotrombicula*) *sylvilagi* Brennan and Wharton, but differs in lacking whiplike setae on leg III as well as other characters. Closely related to *Trombicula kardosi* sp. nov., with differences noted under *T. kardosi.*

Description of larva.—Body: Holotype (partially engorged) 400 by 265 (engorged 560 by 460, unengorged 180 by 163), yellow in life. Eyes 2/2, bright red in life, anterior slightly larger than posterior, ocular plate obscure; distance across both eyes 24, width 10.

Dorsal setal formula 2-6-6-4-4-4-2, total 28; humeral seta measures 55; anterior dorsal seta 46, posterior dorsal seta 41. Ventral setal formula 2-2-10 plus 28, total 42; anterior sternal seta measures 43, posterior sternal seta 33, anterior ventral seta 30, posterior ventral seta 34. Total body setae 70.

Scutum: Roughly pentagonal, posterior margin deeply rounded; punctae small and scattered; sensillae flagelliform with 12 and 14 branches on distal two thirds, two barbs on proximal third; bases of sensillae situated nearly in line with bases of posterolateral setae. Scutal measurements for holotype: AW- 68, PW- 79, SB- 27, ASB- 28, PSB- 29, AP- 24.5, AM- 42, AL- 32, PL- 55, S- 71. Average of ten specimens and extremes (four topotypes and six from Douglas County): AW- 65 (59-69), PW- 79 (71-82), SB- 26 (24-28), ASB- 28 (25-31), PSB- 31.5 (29-33), AP- 24.5 (22-28), AM- 43 (40-45), AL- 35 (32-37), PL- 55 (51-60), S- 70 (65-74).

Gnathosoma: Cheliceral blade long and slender, slightly curved, one prominent tricuspid cap, cheliceral base punctate. Galeal seta with five branches. Capitular sternum punctate, and with a pair of branched setae. Palpal femur and genu punctate and each with one branched seta; tibia with three branched setae; tarsus with spur (8μ) and six branched setae. Palpal claw stout, trifurcate, axial prong internal, outer prongs short.

Legs: Leg I coxa, trochanter and basifemur each with one branched seta; telofemur with five branched setae; genu with four branched setae, three long genualae and a microgenuala; tibia with eight branched setae, two stout tibialae and a microtibiala; tarsus with approximately 17 branched setae, spur (19μ), microspur, subterminala, parasubterminala and pretarsala. Leg II coxa and tro-

chanter each with one branched seta; basifemur with two branched setae; telofemur with four branched setae; genu with three branched setae and a long genuala; tibia with six branched setae and two tibialae; tarsus with approximately 14 branched setae, spur (14μ), microspur and pretarsala. Leg II coxa and trochanter each with one branched seta; basifemur with two branched setae; telofemur with three branched setae; genu with five branched setae and a long genuala; tibia with six branched setae and a long tibiala; tarsus with approximately 12 branched setae. All leg segments with punctae. The branched setae on all legs seemingly with setules projecting from a single plane; however, most if not all leg setae actually with two rows of setules, not set far enough apart to always extend out on both sides of seta when mounted on a slide. Proximal leg segments with branched setae long and rodlike with numerous fine setules (Fig. 17.), while on distal segments most of setae shorter with fewer and larger setules. Tarsus III with at least one long branched rodlike seta reminiscent of the long whiplike setae or their replacements in the subgenus *Neotrombicula.*

Remarks.—The larvae of this species appear in the late fall and winter. These chiggers seldom attach in or on the ears, but are found over the body, legs and base of the tail of the host.

This species has been reared to the second generation from larvae taken at the type locality by L. J. Lipovsky.

Specimens examined.—Total, 222 larvae, as follows. KANSAS. *Douglas Co.: Sciurus niger,* Jan. 19, 1950, KU 3375; Lawrence, *Sciurus niger,* March 27, 1948, KU 3310-3313, March 29, 1952, KU 3385-89(7), Nov. 16, 1952, KU 3391; 4 mi. S, 2 mi. W Lawrence, *Sciurus niger,* Nov. 18, 1950, KU 3376-79 (9); 2 mi. S Worden, *Sciurus carolinensis,* Nov. 26, 1949, KU 3315-3353 -*Sciurus niger,* Nov. 26, 1949, KU 3354-59, Nov. 28, 1949, KU 3368-74, -*Sciurus carolinensis* and *S. niger* (mixed), Nov. 26, 1949, KU 3360-67; 4½ mi. W, 3 mi. S Baldwin, *Sciurus niger,* Nov. 28, 1951, KU 3382-84; 5 mi. N, 1 mi. E Lawrence, Univ. Kansas Nat. Hist. Reservation, *Elaphe obsoleta,* Sept. 10, 1952, KU 3390. *Jefferson Co.:* 5½ mi. N, ½ E Lawrence, *Sciurus niger,* Nov. 21, 1951, KU 3380-81. *Miami Co.:* 3 mi. E, 1 mi. S Fontana, *Sciurus,* Oct. 12, 1948, KU 3314. *Barber Co.:* 4 mi. S Aetna, *Myotis velifer,* April 10, 1949, KU 3180-3194 (second generation, KU 3195-3247); -*Neotoma micropus,* April 11-14, 1949, KU 3248-51 (second generation, KU 3252-3309). NEBRASKA. *Otoe Co.:* 3 mi. S, 2 mi. E Nebraska City, *Sciurus niger,* Oct. 10, 1953, KU 3392-96. ILLINOIS. *Piatt Co.:* Monticello, *Glaucomys volans,* Oct. 24, 1948, RML (12).

Trombicula kardosi * sp. nov.

Figs. 19, 21

Types.—Larvae: Holotype, slide KU 3151, and 25 paratypes, KU 3152-74, Snow Entomological Museum, University of Kansas, from 4½ miles west, 3 miles south of Baldwin, Douglas County, Kansas, taken from two fox squirrels, *Sciurus niger* Linnaeus, field no. RL511128-3, shot on November 28, 1951, by R. B. Loomis.

Diagnosis.—Larva similar to *Trombicula fitchi* sp. nov., but differs in having galeal seta with fewer branches; palpal femur, genu and tibia with nude setae; scutum with posterior angle wider and more shallow; with more marginate lateral edges anterior to bases of posterolateral setae; sensilla longer, with fewer branches; and in having the spurs on tarsi I and II slightly longer.

Description of larva.—Holotype (engorged) 510 by 350; yellow in life. Eyes 2/2, red in life, subequal, length across both eyes, 21, width 8.

Dorsal setal formula 2-6-6-4-4-4, total 26; humeral seta measures 55, anterior dorsal seta 48, posterior dorsal seta 45. Ventral setal formula 2-2 plus 40, total 44; anterior sternal seta measures 40, posterior sternal seta 39, anterior ventral seta 28, posterior ventral seta 44.

Scutum: Shape of scutum roughly pentagonal, posterior margin rounded, lateral margins indented just above bases of PL's; scattered small punctae. Sensillae with seven branches. Scutal measurements of holotype: AW- 64, PW- 80, SB- 23, ASB- 28, PSB- 28, AP- 24, AM- 45, AL- 33, PL- 52, S- 76. Average and extremes of five paratypes: AW- 67 (65-69), PW- 82 (80-85), SB- 25 (23-28), ASB- 28 (26-29), PSB- 28 (28-30), AP- 25 (24-26), AM- 45 (43-48), AL- 35 (33-38), PL- 52 (51-54), S- 79 (78-81).

Gnathosoma: Galeal seta with two branches (2-3 branches). Palpal femur and genu each with one nude seta; tibia with three nude setae; tarsus with spur (7μ) and six branched setae. Other characters as found in *T. fitchi.*

Legs: Branched and specialized nude setae similar to *T. fitchi.* Tarsus I with spur 21μ (21-22); tarsus II with spur 15μ (15-18). All coxae with distinct punctae, other leg segments with faint punctae.

Remarks.—Trombicula kardosi and *T. fitchi* are closely related,

* Named for Mr. Ervin H. Kardos, formerly of the University of Kansas and now studying chiggers in Korea, in recognition of his excellent study of the subgenus *Neotrombicula* in the Central United States.

and they seem to be related to the subgenus *Neotrombicula,* although there are no whiplike setae present on leg III.

Three specimens of *Trombicula fitchi* were recovered with the type series of 26 *T. kardosi,* from the same two fox squirrels (*Sciurus niger*). This was the only known coexistence of these species in a single locality. Like *T. fitchi,* this species seems to prefer the body surface to the ears of the mammalian hosts.

Mr. D. A. Crossley, Jr. has reared several nymphs, presumably of this species, from engorged larvae taken with the type series of *T. kardosi.*

Specimens examined.—Total, 28 larvae, as follows. KANSAS. *Douglas Co.:* 4½ mi. W, 3 mi. S Baldwin, *Sciurus niger,* Nov. 28, 1951, KU 3151-3174 (total 26) type series. *Allen Co.:* 6½ mi. S Humboldt, *Elaphe obsoleta,* April 27, 1947, KU 3175. UTAH. *Garfield Co.:* Panguitch Lake, Dixie National Forest, *Eutamias umbrinus,* Sept. 24, 1952, KU 3176.

Trombicula arenicola sp. nov.

Figs. 22-26

Types.—Larvae: Holotype, slide KU 3601, and 29 paratypes, KU 3602-3628, Snow Entomological Museum, University of Kansas, from 12 miles northeast of Liberal, Seward County, Kansas, taken from six kangaroo rats, *Dipodomys ordi* Woodhouse, field no. RL 480908-5, caught on September 8, 1948, by R. B. Loomis, L. J. Lipovsky and D. T. Clark.

Diagnosis.—Larva similar to *Trombicula montanensis* Brennan in having palpal claw trifurcate; scutum roughly pentagonal, with posterior margin broadly rounded, and all setae approximately the same length; sensilla flagelliform with distinct branches on distal two-thirds; coxa III with three or four setae; two pairs of sternal setae; and one mastitarsala III. *Trombicula arenicola* differs from *T. montanensis* in having the galeal seta with 2-3 distinct branches; tarsus I with spur (16μ) longer (12-13μ in *T. montanensis*); legs with branched setae having more numerous setules; body setae total approximately 74, dorsal setae 36, formula begins 2-8-8 (2-6-6 in *T. montanensis*), ventral setae 38; and in having the sensilla longer (average 74μ).

Description of larva.—Body: Holotype (slightly engorged) 213 by 192, (engorged 460 by 375), yellow in life. Eyes 2/2, red in life, anterior larger, faint ocular plate, length across both eyes 17, width 8.

Dorsal body setal formula 2-8(9)-8-6-6-4(6)-2, total 36 (to 38); humeral seta measures 41, anterior dorsal seta 31, posterior dorsal seta 35. Ventral setal formula approximately 2-2 plus 26 (to 30) anterior to anus, 14 (10-16) posterior to anus, total 38-44; anterior sternal seta measures 28, posterior sternal seta 28, anterior ventral seta 26, posterior ventral seta 34. Total body setae approximately 74 to 80.

Scutum: Subpentagonal, posterior margin broadly rounded, anterolateral setae slightly shorter than other subequal scutal setae, few scattered small punctae; sensilla flagelliform with approximately 12 branches on distal two thirds and several short basal barbs; sensillary bases in line with bases of PL's. Scutal measurements of holotype: AW- 59, PW- 82; SB- 26, ASB- 25, PSB- 21, AP- 24, AM- 31, AL- 33, PL- 37, S- 73. Averages and extremes of seven topotypes: AW- 58 (53-64), PW- 81 (75-92), SB- 26 (24-28), ASB- 26 (25-28), PSB- 22 (20-25), AP- 24 (20-27), AM- 32 (30-34), AL- 31 (26-33), PL- 35 (31-37), S- 72 (67-75).

Gnathosoma: Cheliceral blade long and slender, slightly curved, one prominent tricuspid cap, faint punctae on cheliceral base. Galeal seta with two to three branches. Capitular sternum with punctae and a pair of branched setae. Palpal femur and genu each with one plumose seta, tibia with dorsal and lateral setae nude, ventral seta with several branches; tarsus with basal spur (8μ), and six branched setae, and a terminal nude seta; palpal claw trifurcate, with central prong largest and curved inward.

Legs: Leg I coxa, trochanter and basifemur each with one branched seta; telofemur with five branched setae; genu with four branched setae, two genualae and one microgenuala; tibia with eight branched setae, two tibialae and one microtibiala; tarsus with approximately 14 branched setae, a spur (17μ), microspur, subterminala, parasubterminala and pretarsala. Leg II coxa and trochanter each with one branched seta; basifemur with two branched setae; telofemur with four branched setae; genu with three branched setae and a genuala; tibia with five branched setae and two tibialae; tarsus with approximately 12 branched setae, a spur (16μ), microspur and pretarsala. Leg III coxa with three setae (three and four, or four setae); trochanter with one branched seta; basifemur with two branched setae; telofemur with three branched setae; genu with three branched setae and a genuala; tibia with six branched setae and a tibiala; tarsus with approximately 12 branched setae and one mastitarsala. Legs with long

plumose setae with numerous fine setules, particularly evident in the central segments but more difficult to separate from setae with fewer branches on the distal segments.

Remarks.—Specimens of *T. arenicola* from other localities agree in all important characters with the type series.

Trombicula arenicola was compared with ten paratypes from Montana as well as several hundred other specimens of *Trombicula montanensis,* from Colorado, Nebraska, Kansas, Oklahoma and Texas. The differences listed in the diagnosis were present in every specimen examined of both species. The two species were found within eight miles of each other in Seward County, Kansas, *T. montanensis* from 4 miles northeast and *T. arenicola* from 12 miles northeast of Liberal, suggesting a slight overlap in distribution. *Trombicula arenicola* was obtained from the sand-sage valley of the Cimarron River, and it was this sandy habitat that suggested the specific name.

The number of setae on coxa III shows a variation from three on both (16 specimens), three and four (9) and four on both coxae (5) in the type series of thirty specimens. This variation is similar to that found in *T. montanensis.*

Specimens examined.—Total, 119 larvae, as follows. ALBERTA: Lomond, *Citellus richardsoni,* June 25, 1950, RML (1), and the house mouse, *Mus musculus,* June 27, 1950, RML (6). UTAH. *Tooele Co.:* Tooele, Dugway Proving Ground, *Dipodomys microps,* Sept. 15, 1951, RML (6), Oct. 18, 1951, RML (4), *-Dipodomys ordi,* Oct. 24, 1951, RML (6), *-Perognathus parvus,* Aug. 28, 1951, RML (3). NEW MEXICO. *Santa Fe Co.: Dipodomys ordi,* Oct. 2 (2), 4 (4), 17 (6), 30 (2), Dec. 4 (3), 1951, all RML, and *Perognathus flavus,* Oct. 24, 1951, RML (8). COLORADO. *Prowers Co.:* Two Buttes peak, 4500 ft., *Neotoma albigula,* May 9, 1950, KU 3644-47 and *Dipodomys ordi,* May 11, 1950, KU 3648-68. KANSAS. *Seward Co.:* 12 mi. NE Liberal, Sept. 8-10, 1948, *Dipodomys ordi,* KU 3601-36, *-Perognathus hispidus,* KU 3637-42, *-Muscivora forficata,* KU 3643.

DISTRIBUTION OF PARATYPES

Paratypes of each species will be sent to the United States National Museum; Rocky Mountain Laboratory, Hamilton, Montana; and the British Museum (Natural History). Paratypes of all of the species, except *Trombicula twentei*, will be sent to The South Australian Museum, Adelaide; Dr. G. W. Wharton, University of Maryland; Dr. Charles D. Radford, Manchester, England; Museum National d'Histoire Naturelle, Paris, France; Army Medical Service Graduate School, Washington, D. C.; and Dr. J. R. Audy, Institute for Medical Research, Kuala Lumpur, Malaya.

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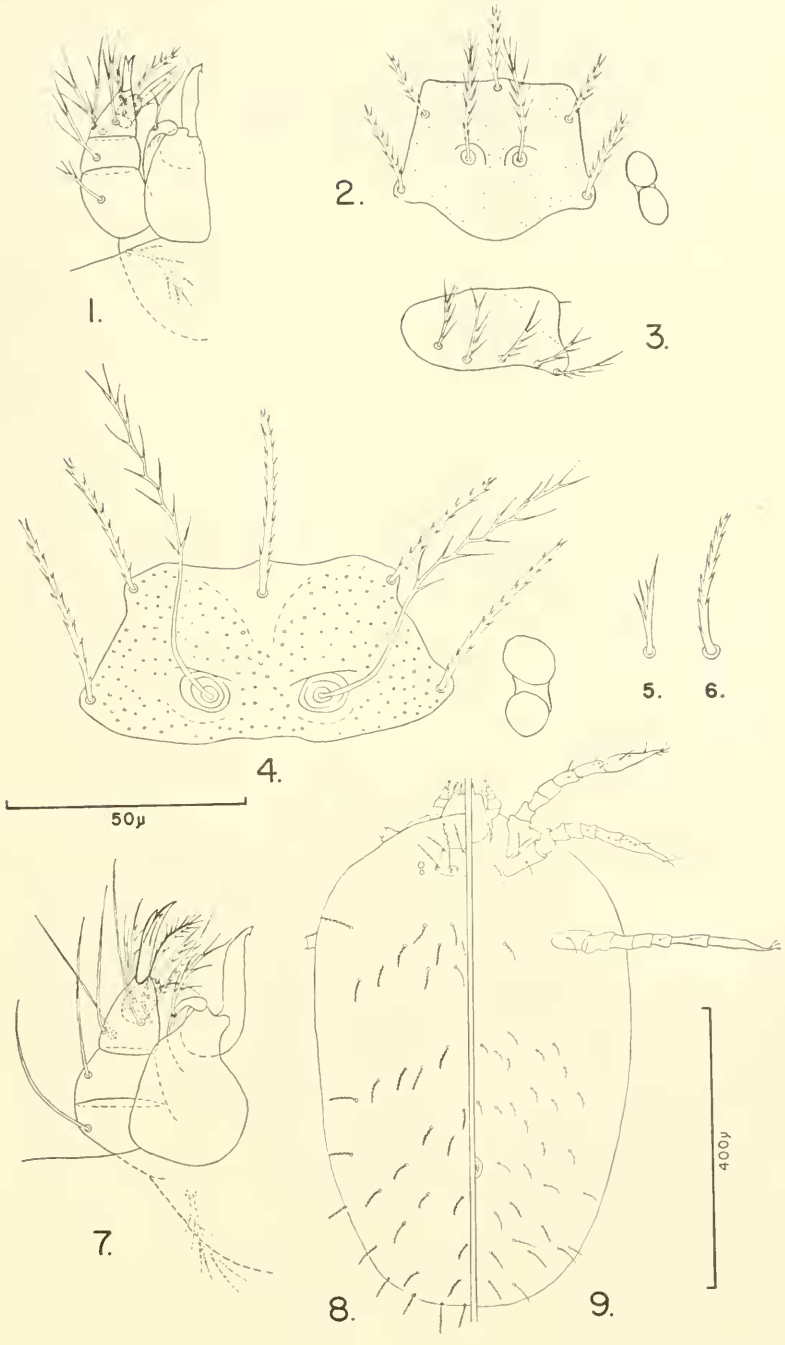
EXPLANATION OF PLATE I

Trombicula crossleyi sp. nov.

FIG. 1. Gnathosoma.
FIG. 2. Scutum and eyes.
FIG. 3. Coxa III.

Trombicula (*Leptotrombidium*) *twentei* sp. nov.

FIG. 4. Scutum and eyes.
FIG. 5. Anterior ventral seta.
FIG. 6. Anterior dorsal seta.
FIG. 7. Gnathosoma.
FIG. 8. Dorsal aspect of body.
FIG. 9. Ventral aspect showing nude setae on the legs.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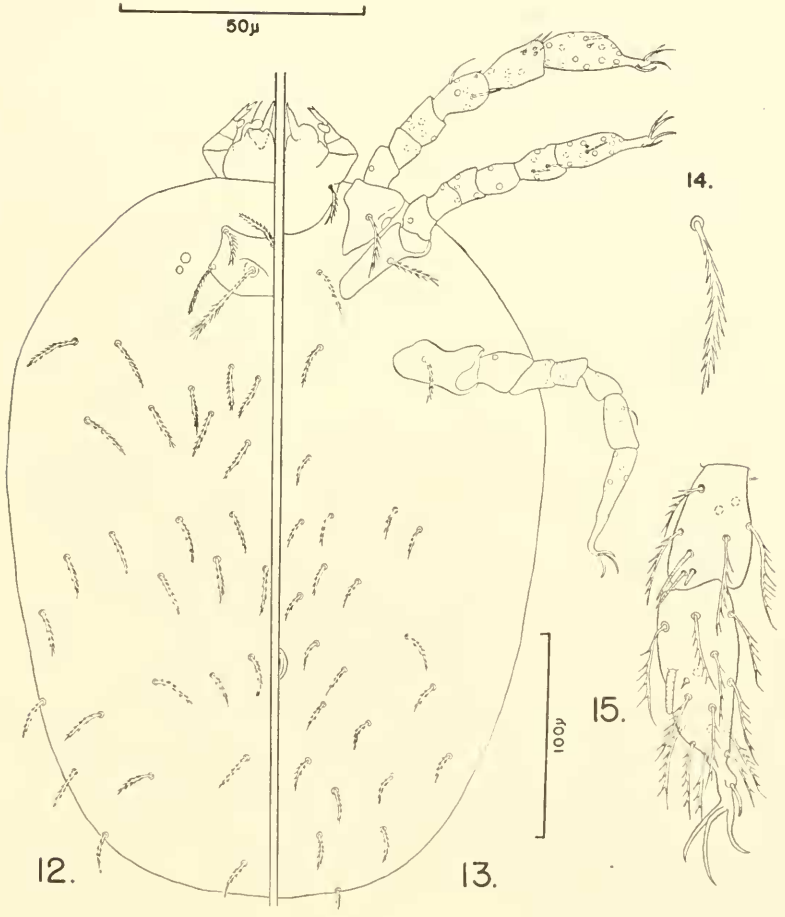
400μ

EXPLANATION OF PLATE II

Trombicula (*Euschöngastoides*) *hoplai* subgen. et sp. nov.

FIG. 10. Gnathosoma.
FIG. 11. Scutum and eyes.
FIG. 12. Dorsal aspect of body.
FIG. 13. Ventral aspect, showing nude setae of the legs.
FIG. 14. Anterior dorsal seta.
FIG. 15. Tibia and tarsus of Leg I.


10.
11.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EXPLANATION OF PLATE III

Trombicula fitchi sp. nov.

FIG. 16. Dorsal aspect of body.

FIG. 17. Ventral aspect, showing a long branched seta and nude setae on the legs.

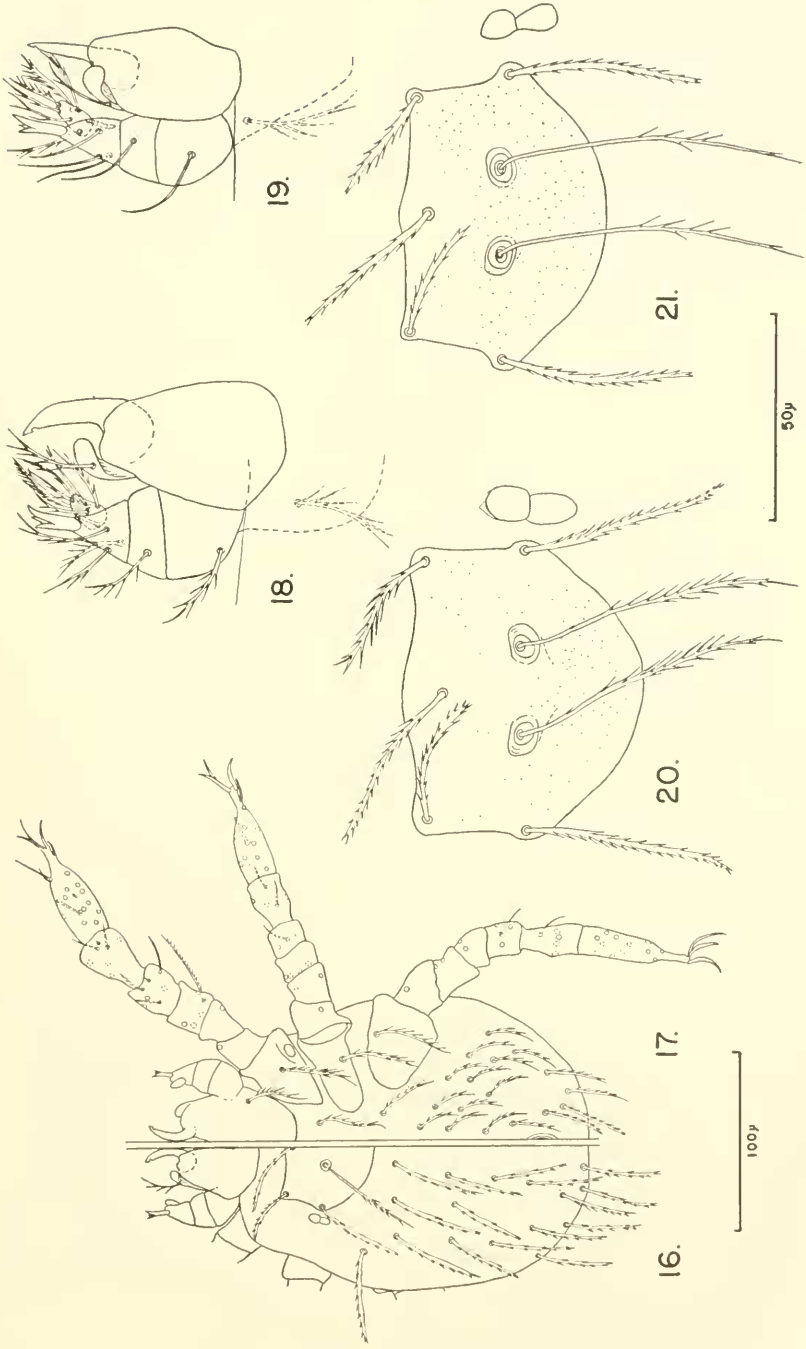
FIG. 18. Gnathosoma.

FIG. 20. Scutum and eyes.

Trombicula kardosi sp. nov.

FIG. 19. Gnathosoma.

FIG. 21. Scutum and eyes.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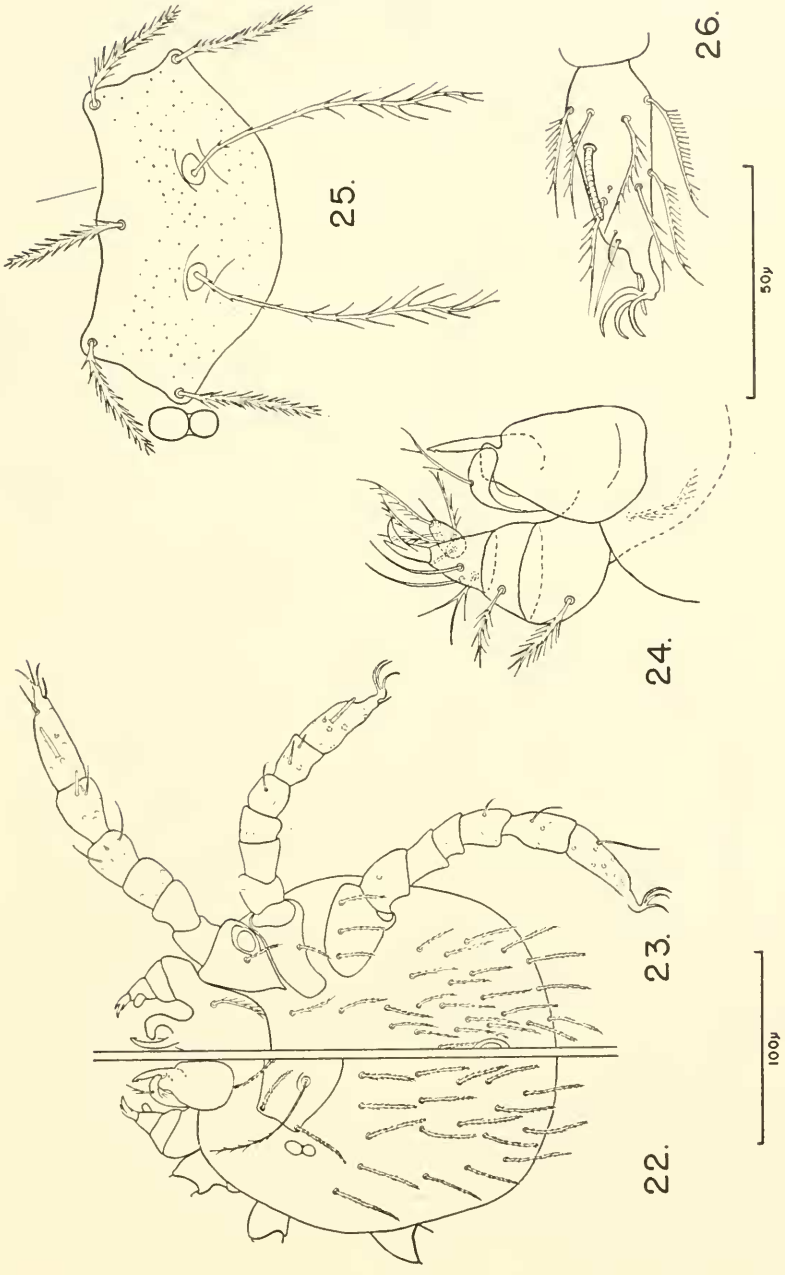
EXPLANATION OF PLATE IV

Trombicula arenicola sp. nov.

FIG. 22. Dorsal aspect of body.
FIG. 23. Ventral aspect, showing nude setae on the legs.
FIG. 24. Gnathosoma.
FIG. 25. Scutum and eyes.
FIG. 26. Tarsus I.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